EMC CCB review
RUC upgrade – Sept08

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Major transitions:

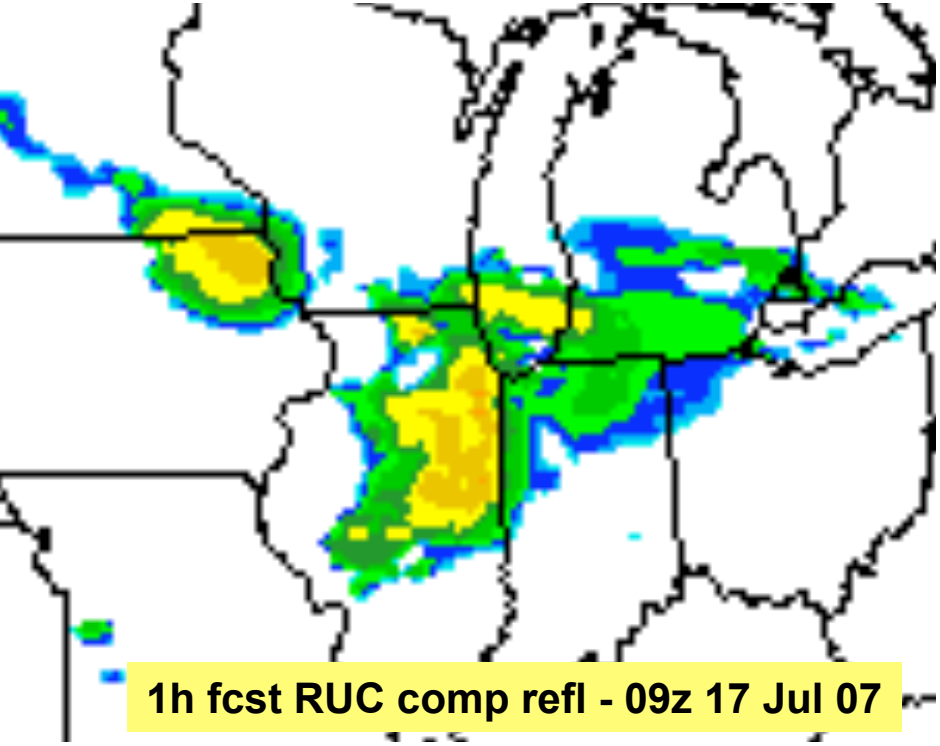
- RUC13 change package
  – radar reflectivity assimilation, TAMDAR, mesonet, model physics – radiation, convection, LSM

Mon 12 May 2008

NCEP

Earth System Research Laboratory
SCIENCE, SERVICE & STEWARDSHIP

RUC Upgrade at NCEP



RUC 13 change package

- Components
  - Assimilation of new obs - radar reflectivity, TAMDAR wind/ temp/RH, mesonet winds
  - Improved surface, precip, reflectivity forecasts
- Status
  - in real-time parallel testing at NCEP (since Aug 2007)
  - Retrospective tests not easy with addition of radar reflectivity data

NCEP RUC parallel web site:
http://www.emc.ncep.noaa.gov/mmb/ruc2/para
Comparisons between para and oper RUC

Changes for oper RUC upgrade

- Assimilation
  - Use of **radar reflectivity** in diabatic DFI in RUC model (also, hydrometeor assimilation component)
  - **Mesonet winds** using mesonet station uselist
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  - Higher obs error for moisture, wind observations
- Model physics
  - RRTM longwave radiation - eliminates sfc warm bias
  - Mod to Grell-Devenyi – decrease areal coverage
  - Mods to RUC land-sfc model
    - fresh snow density - nighttime temps over snow cover
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Scientific results

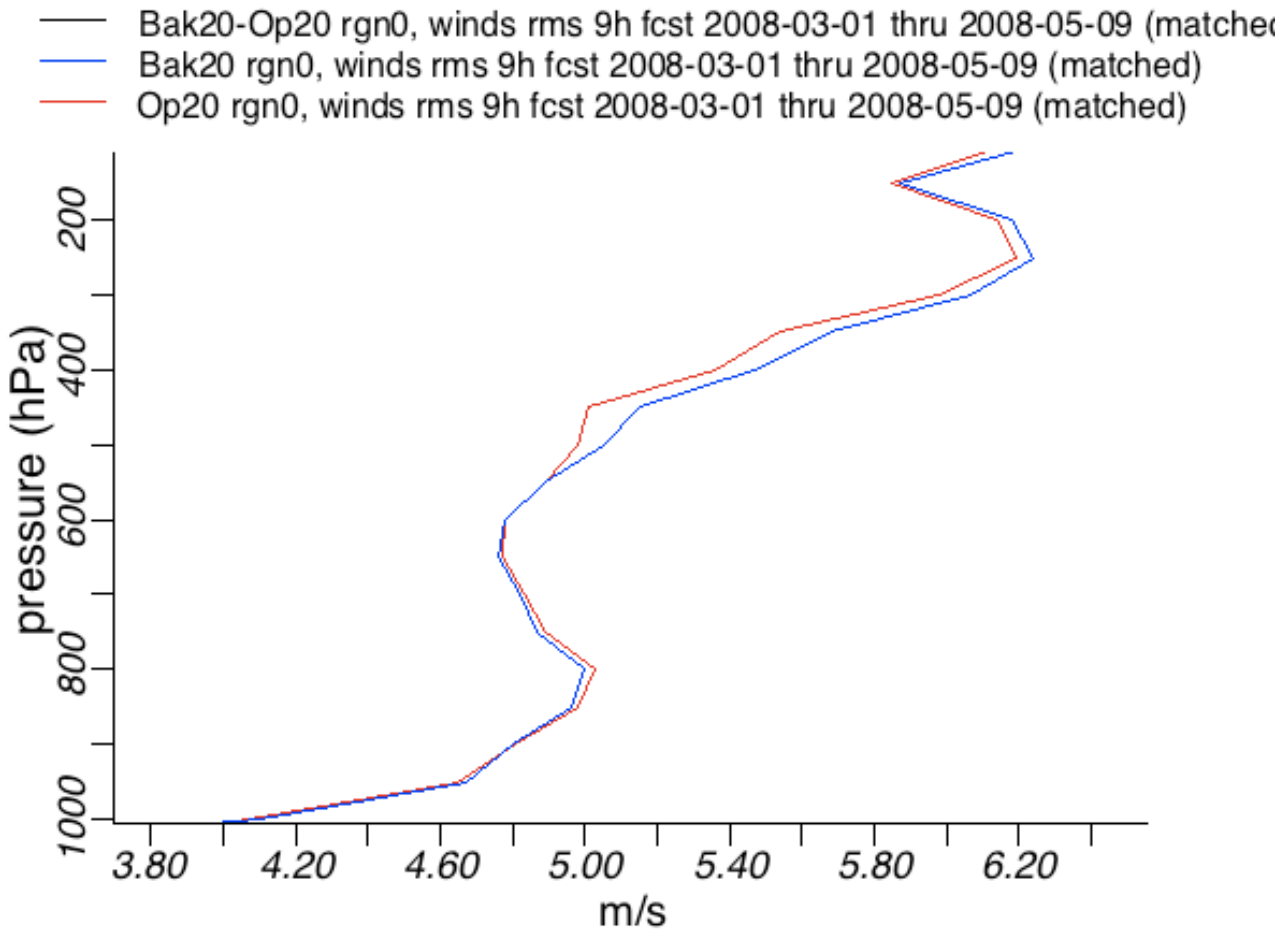
- **ESRL/GSD – ongoing RUC parallel cycle with full radar reflectivity since March 2007**

- **EMC – ongoing parallel cycle since Aug 2007. Radar reflectivity availability became more reliable in Feb 2008**

Following multi-month comparisons

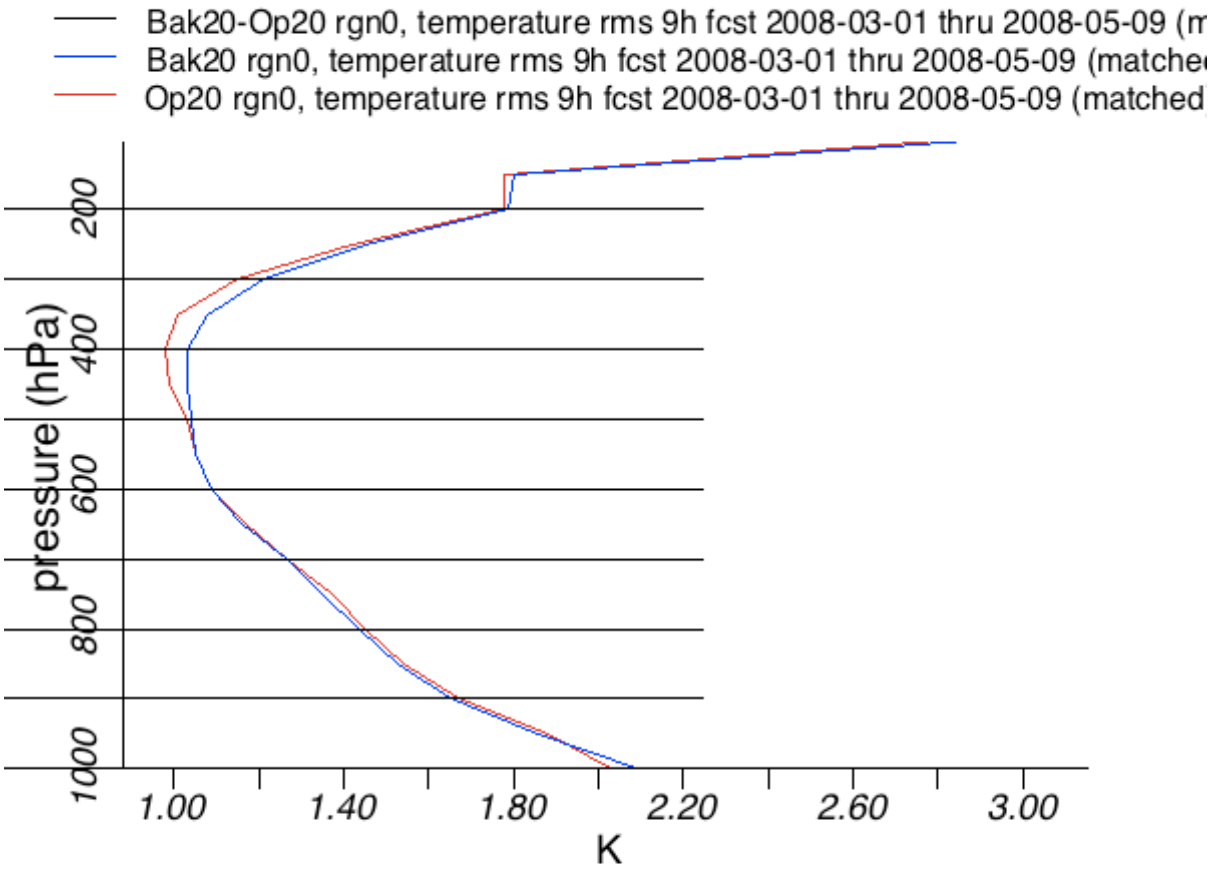
- **Bak20**
  - parallel RUC at GSD using same code in parallel RUC testing at EMC
  - 13km RUC output interpolated to 20km
- **Ops 20**
  - operational RUC
  - 13km RUC output interpolated to 20km
-

Parallel test results



- **9h wind forecast**
- **Bak20 – parallel RUC at GSD using same code in testing at EMC**

Parallel test results – 9 h temperature



- 9h temp forecast
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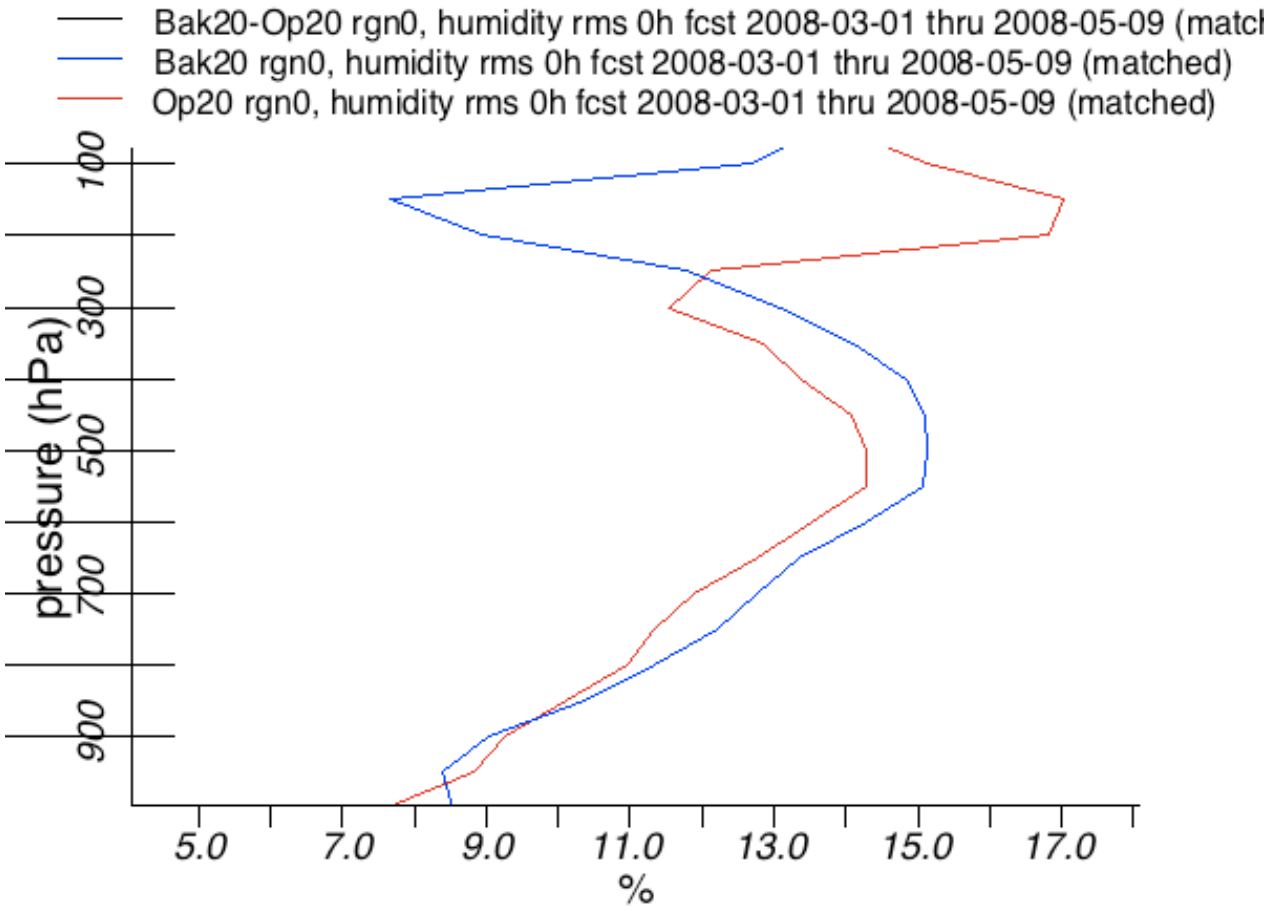
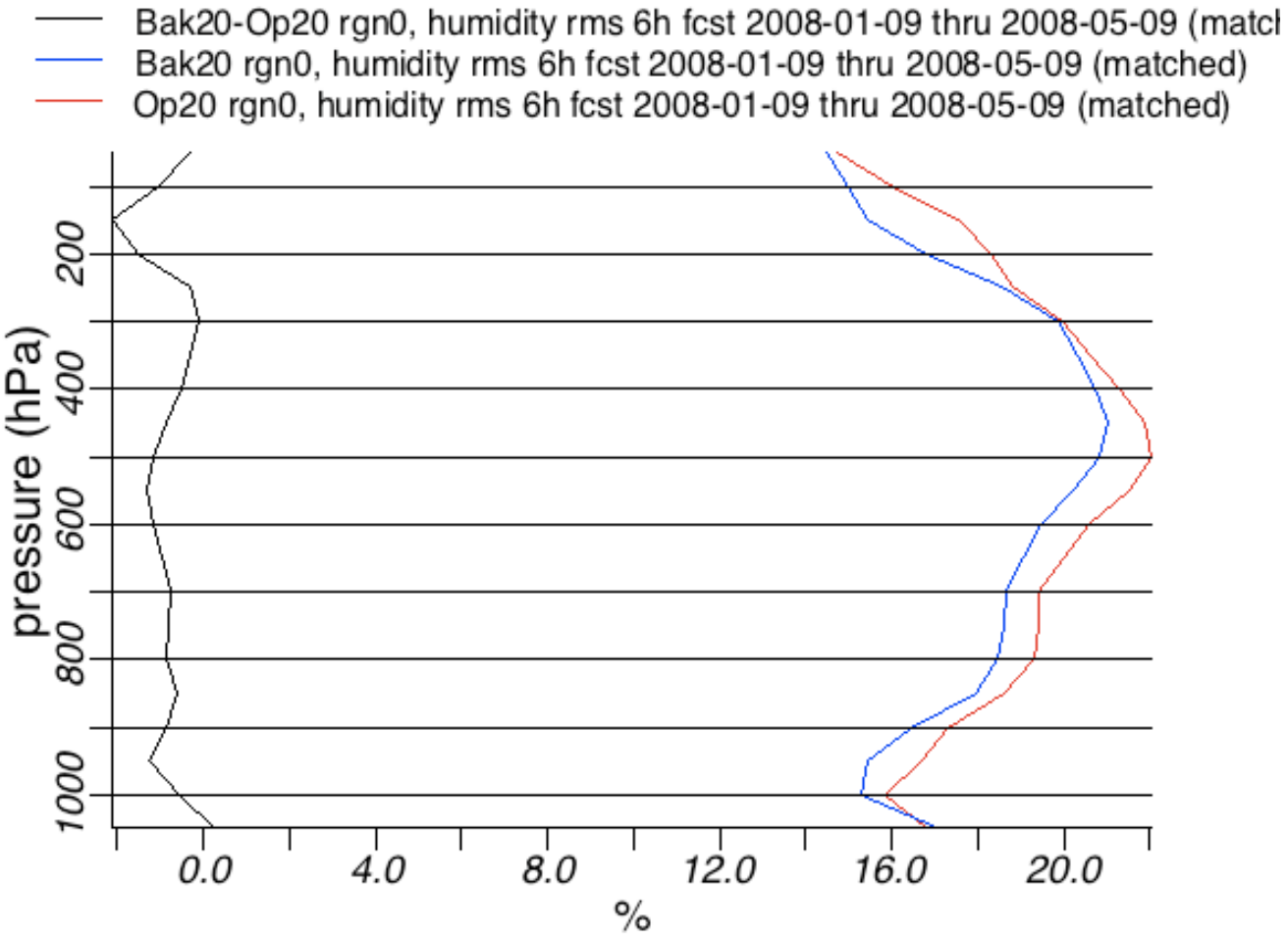
Parallel test results – 0 h RH



- 0h RH analysis
- Bak20 – parallel RUC at GSD using same code in testing at EMC

Parallel test results – 9 h RH



- 9h RH forecast
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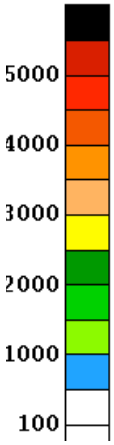
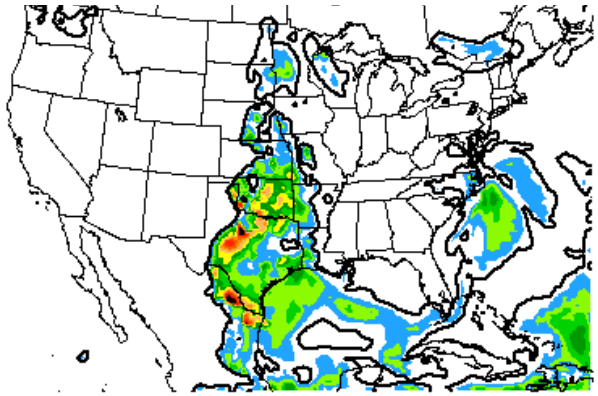
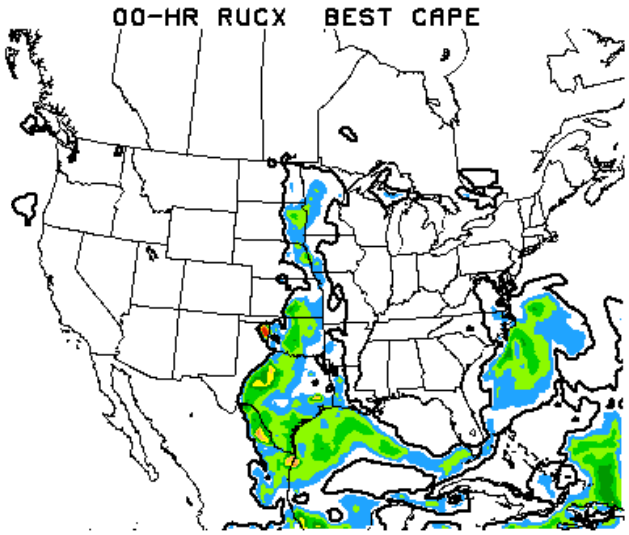
Improved moisture soundings in parallel RUC

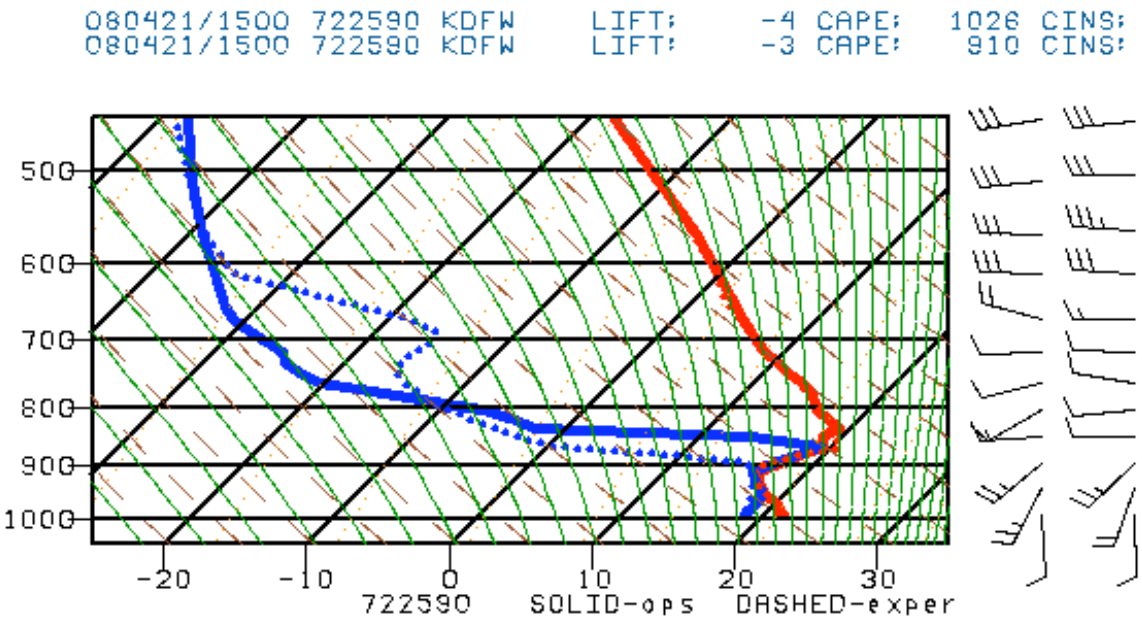




FCST MADE 12Z 04/21

00-HR RUCX BEST CAPE





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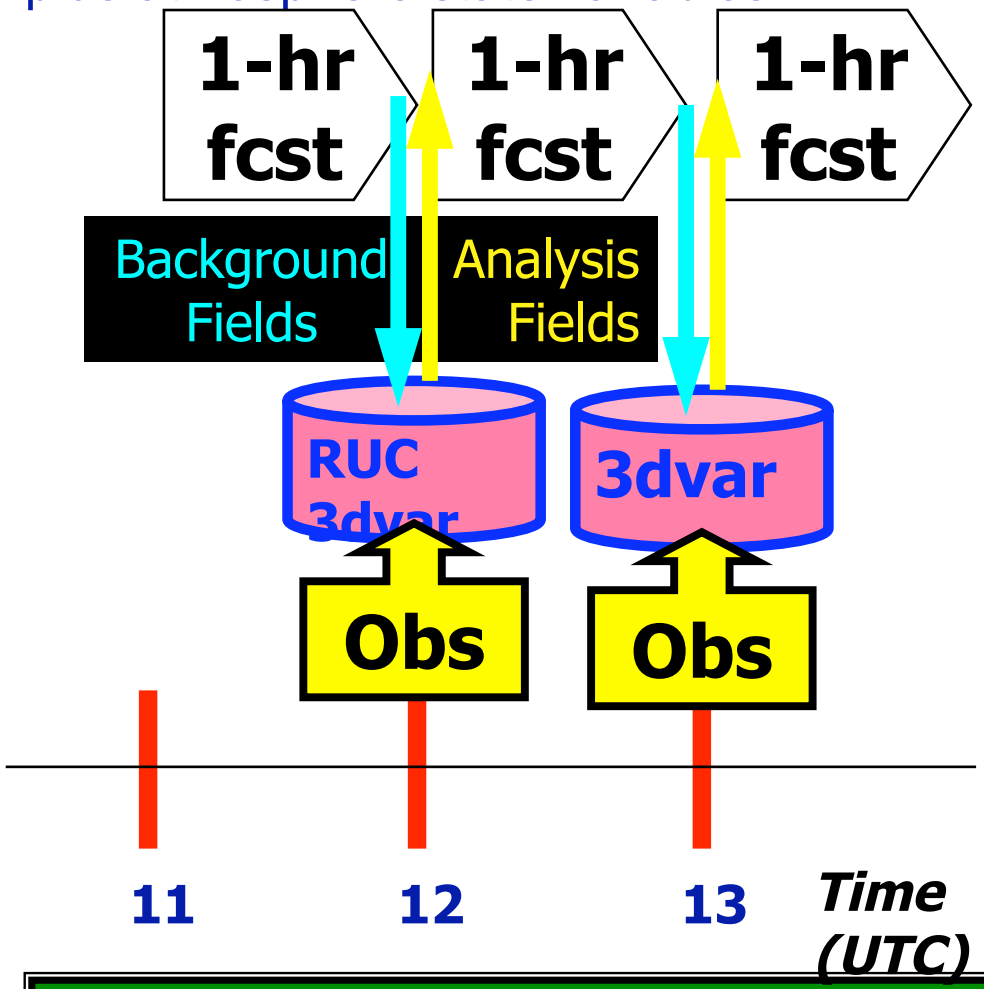
RUC parallel web site:
http://www.emc.ncep.noaa.gov/mmb/ruc2/para

New observations assimilated -- RUC upgrade

Cycle hydrometeor, soil temp/moisture/snow plus atmosphere state variables



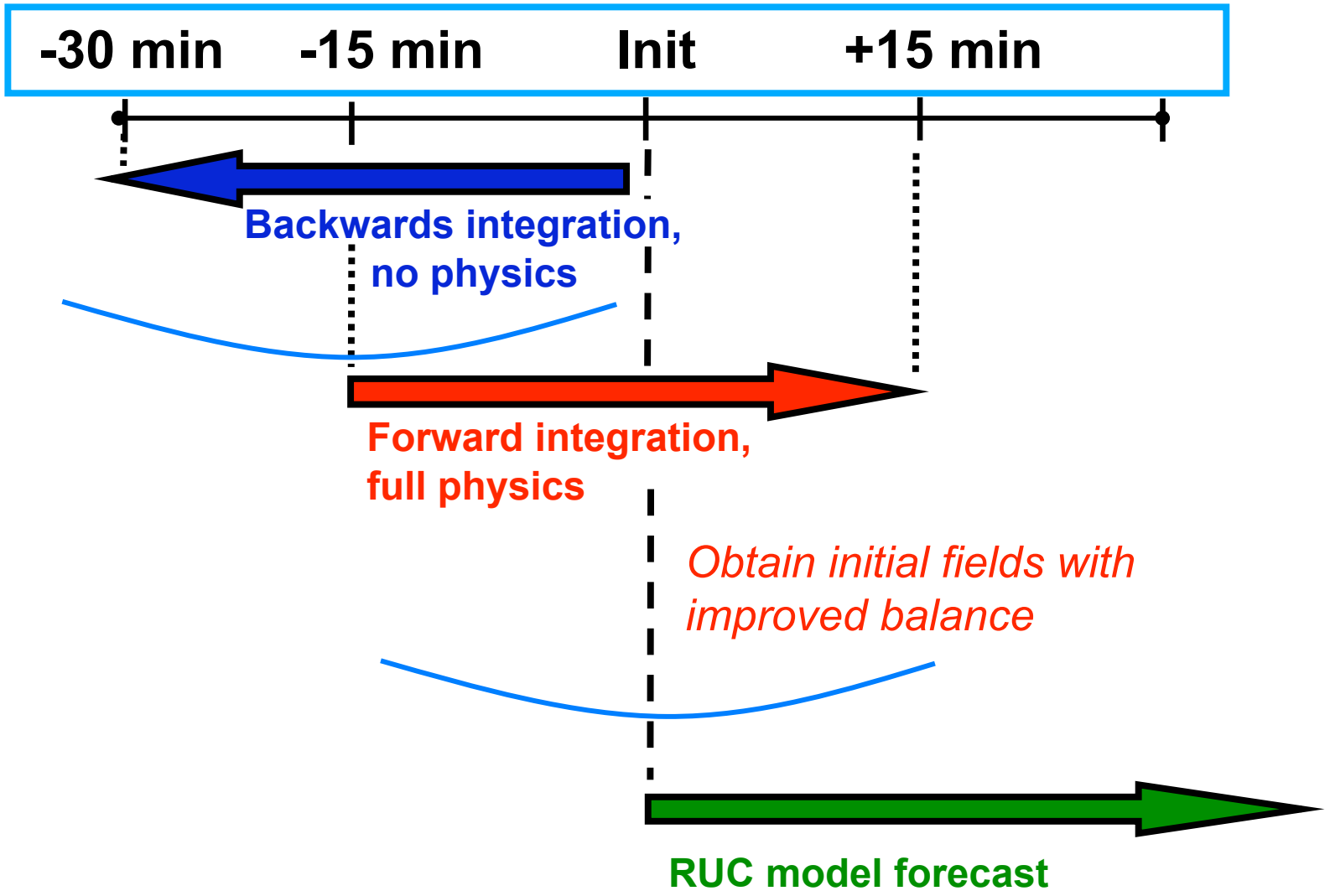
Hourly obs in 2008 RUC

Data Type	~Number
Rawinsonde (12h)	80
NOAA profilers	30
VAD winds	110-130
PBL – prof/RASS	~25
Aircraft (V,temp)	1400-7000
→ **TAMDAR (V,T,RH)**	0 - 800
Surface/METAR	1800-2000
Buoy/ship	100- 200
GOES cloud winds	1000-2500
GOES cloud-top pres	10 km res
GPS precip water	~300
Mesonet (temp, dpt)	~7000
→ **Mesonet (wind)**	2000-4000
METAR-cloud-vis-wx	~1600
→ **Radar reflectivity**	2km

RUC Hourly Assimilation Cycle

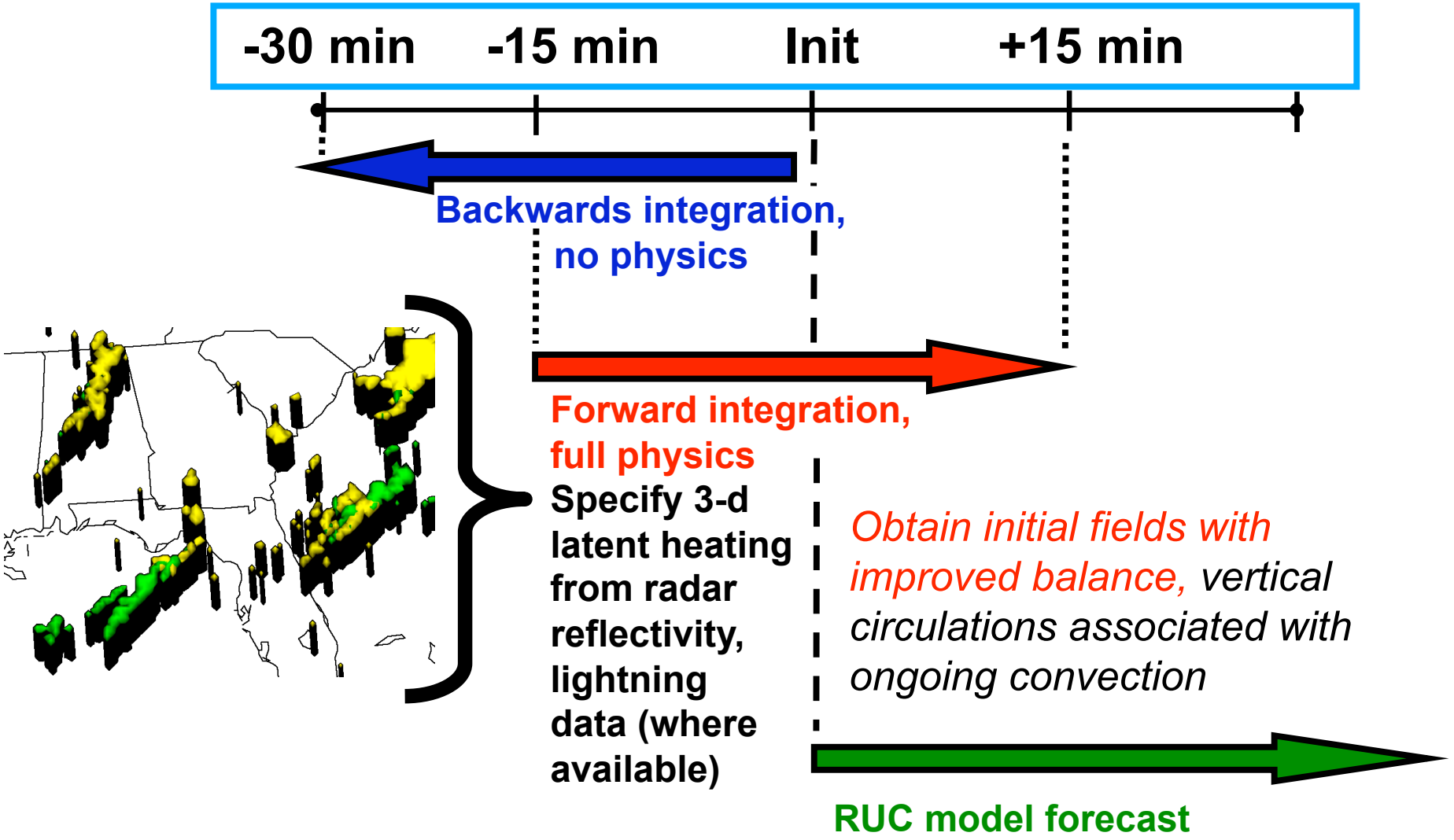
RUC Diabatic Digital Filter Initialization (DDFI)

Initial DFI in RUC model at NCEP - 1998 - adiabatic DFI
Diabatic DFI introduced at NCEP - 2006



Diabatic Digital Filter Initialization (DDFI)

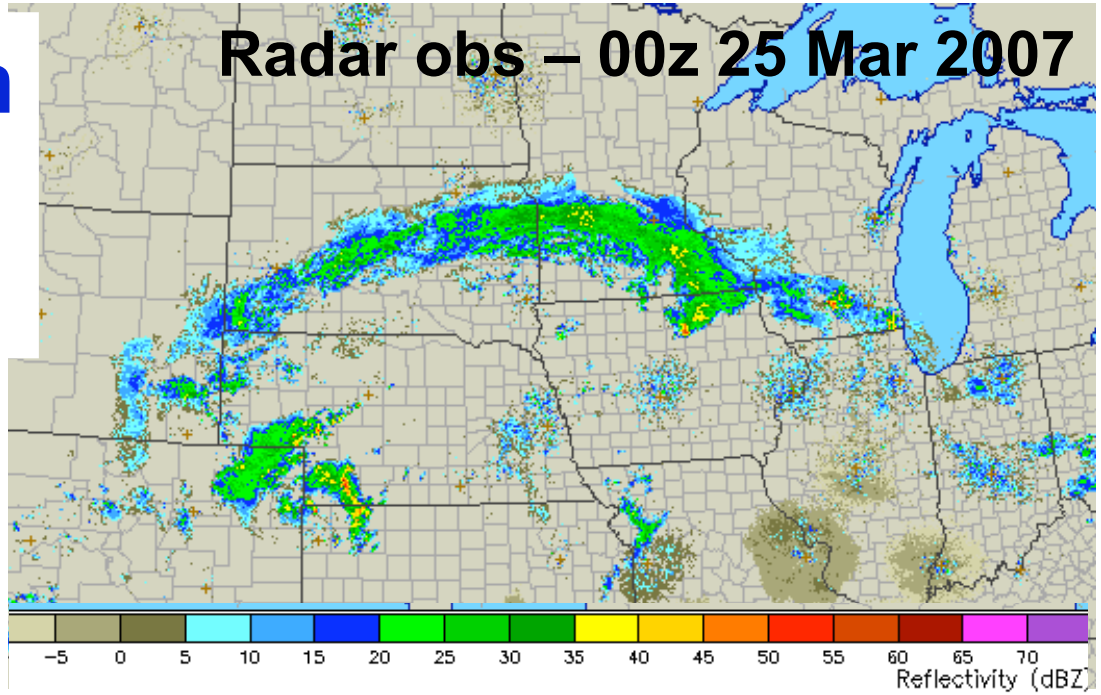
New - add assimilation of radar data



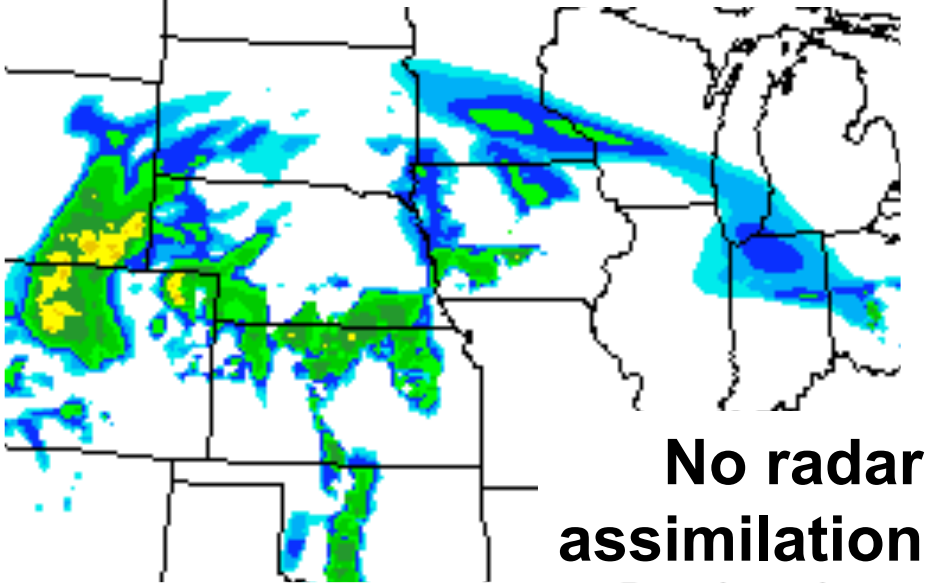
Radar reflectivity assimilation in RUC

Radar assimilation in RUC - winter storm example

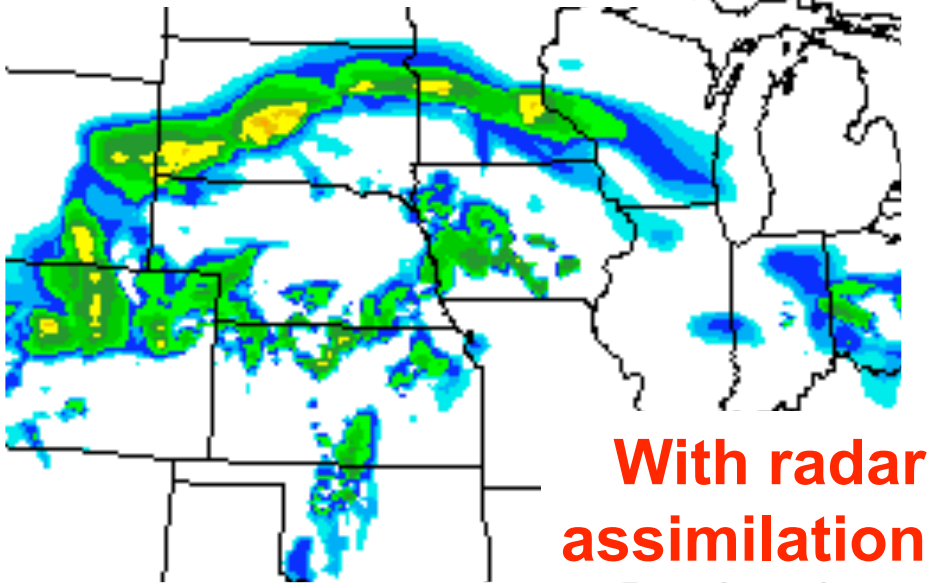
Also, added simulated radar reflectivity field to RUC output



RUC 3-h forecasts valid 00z 25 Mar 2007



No radar assimilation

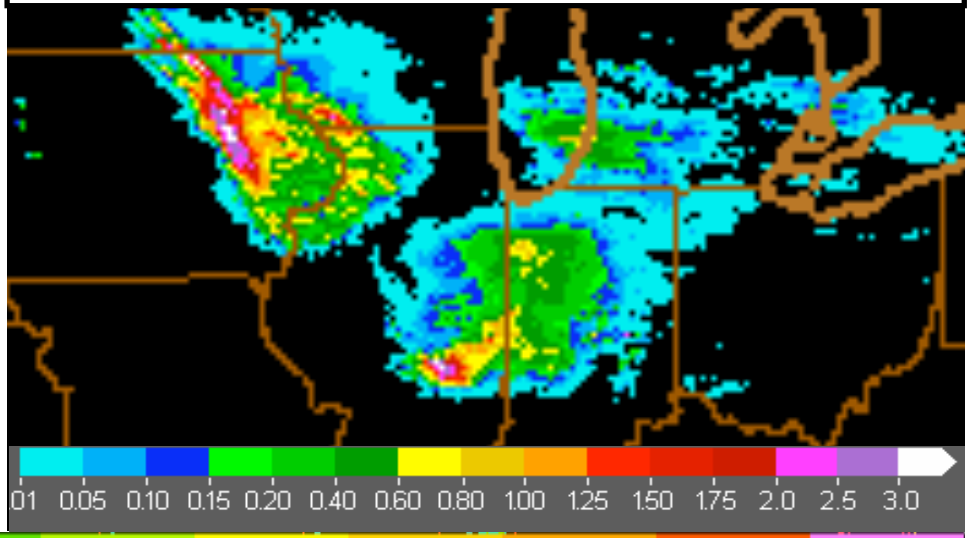


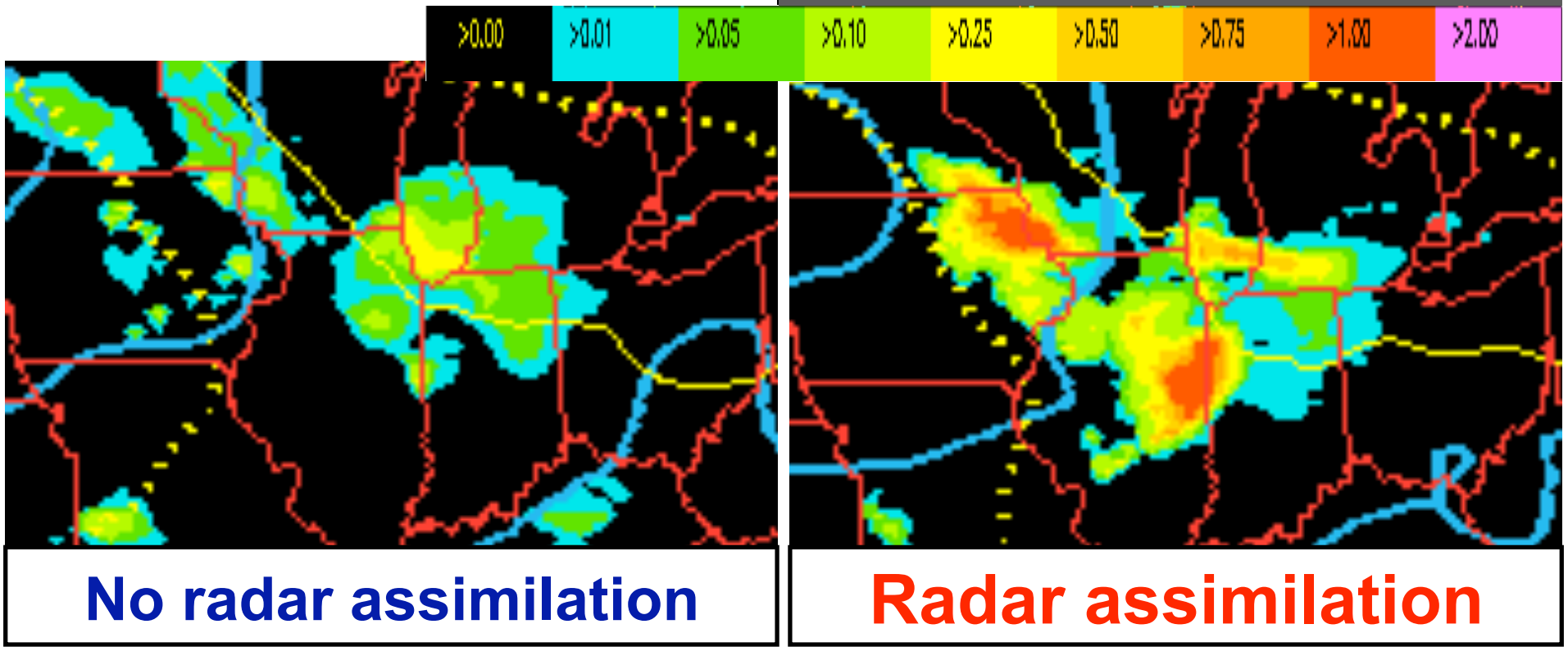
With radar assimilation

Overall effect of RUC radar assimilation

- Overnight convection example

NSSL 12z 3-h accum. Precip.

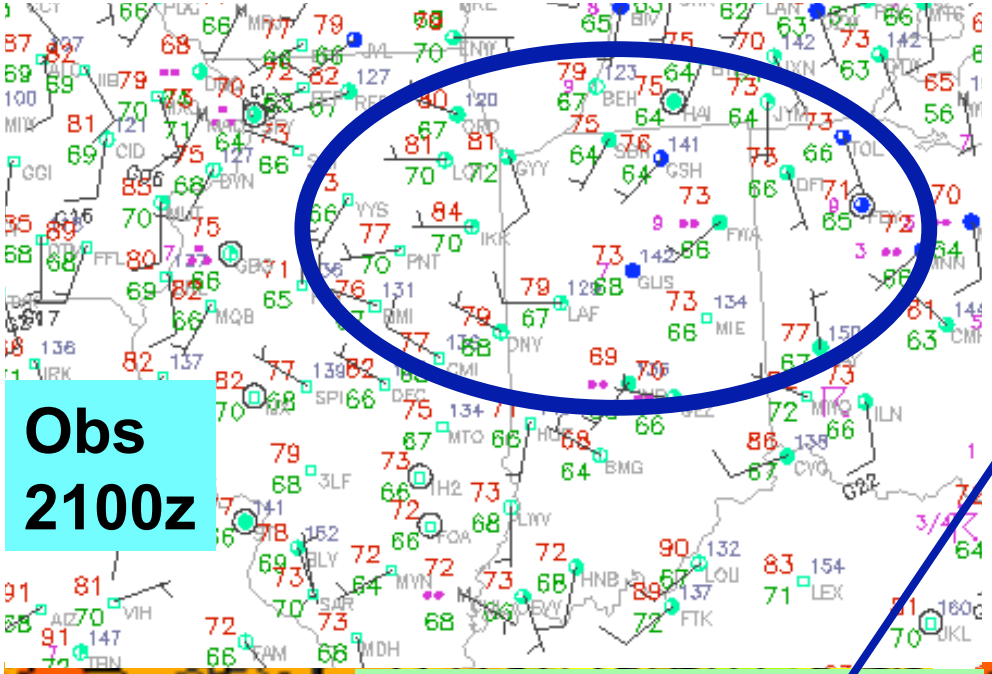




No radar assimilation

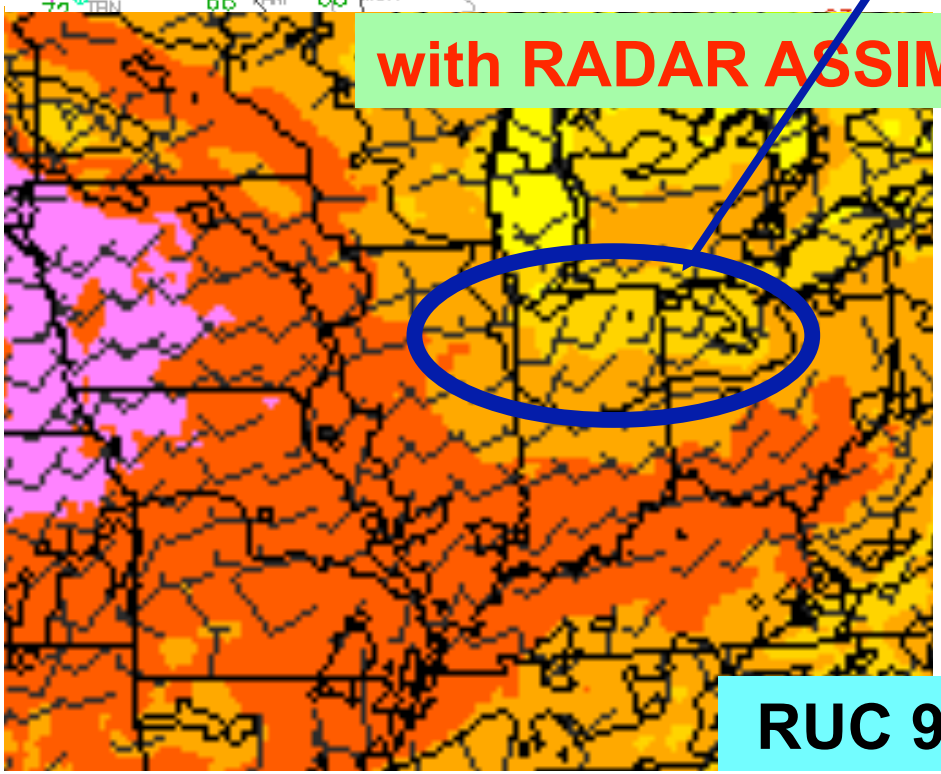
Radar assimilation

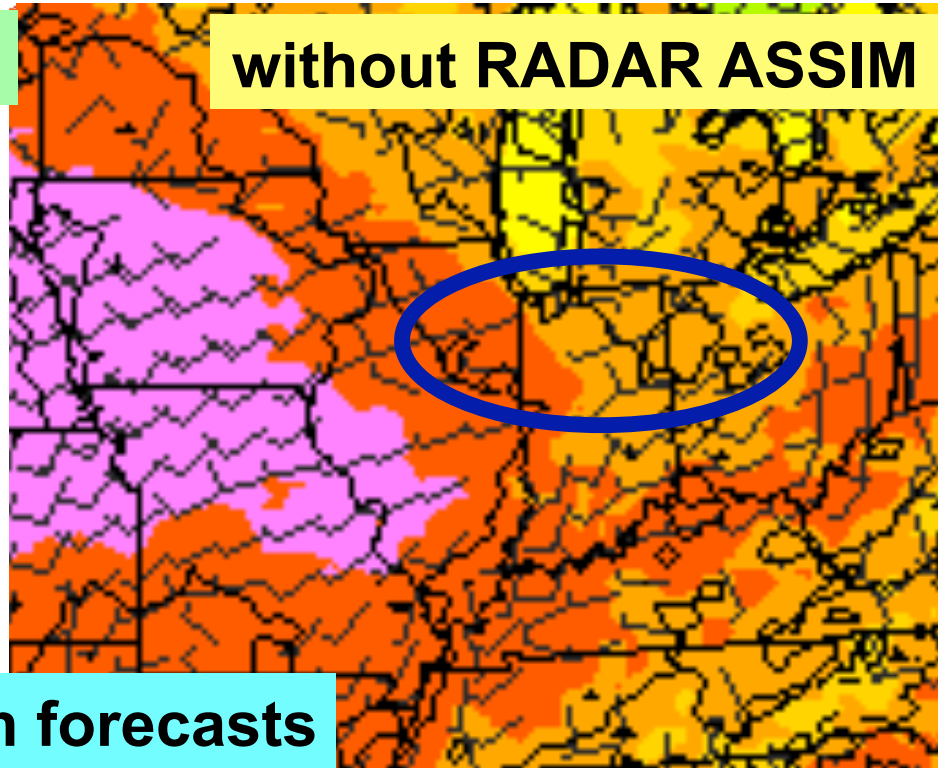
Evaporative cooling - improved cold pool with radar assim



Sfc Temp – 21z
Tues 17 July 2007

>60.0 >70.0 >80.0 >90.0 >100.0

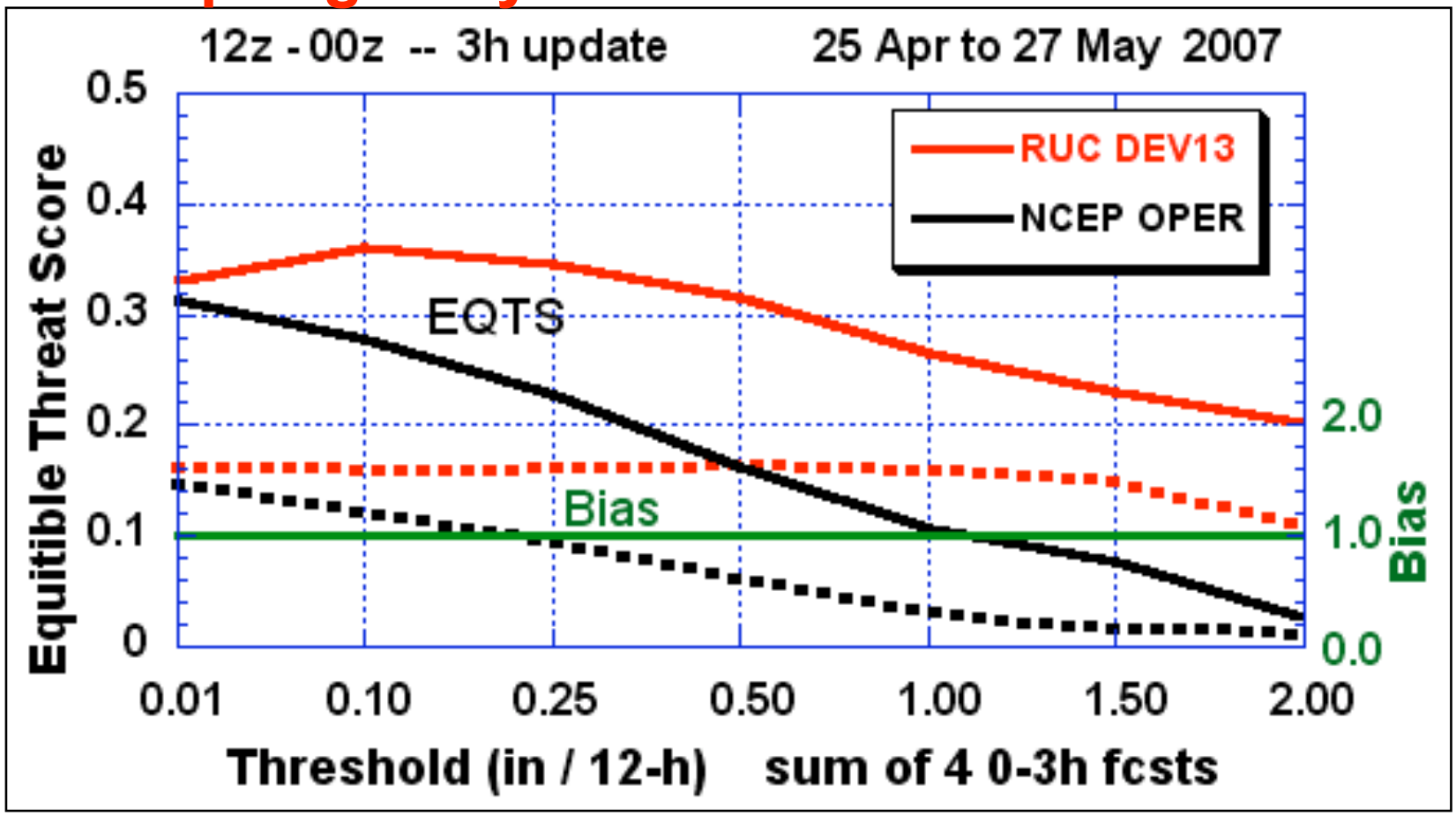




RUC 9h forecasts

Radar assimilation impact on 3-h precipitation skill scores

- Significant improvement in ETS and bias
- Spring - daytime

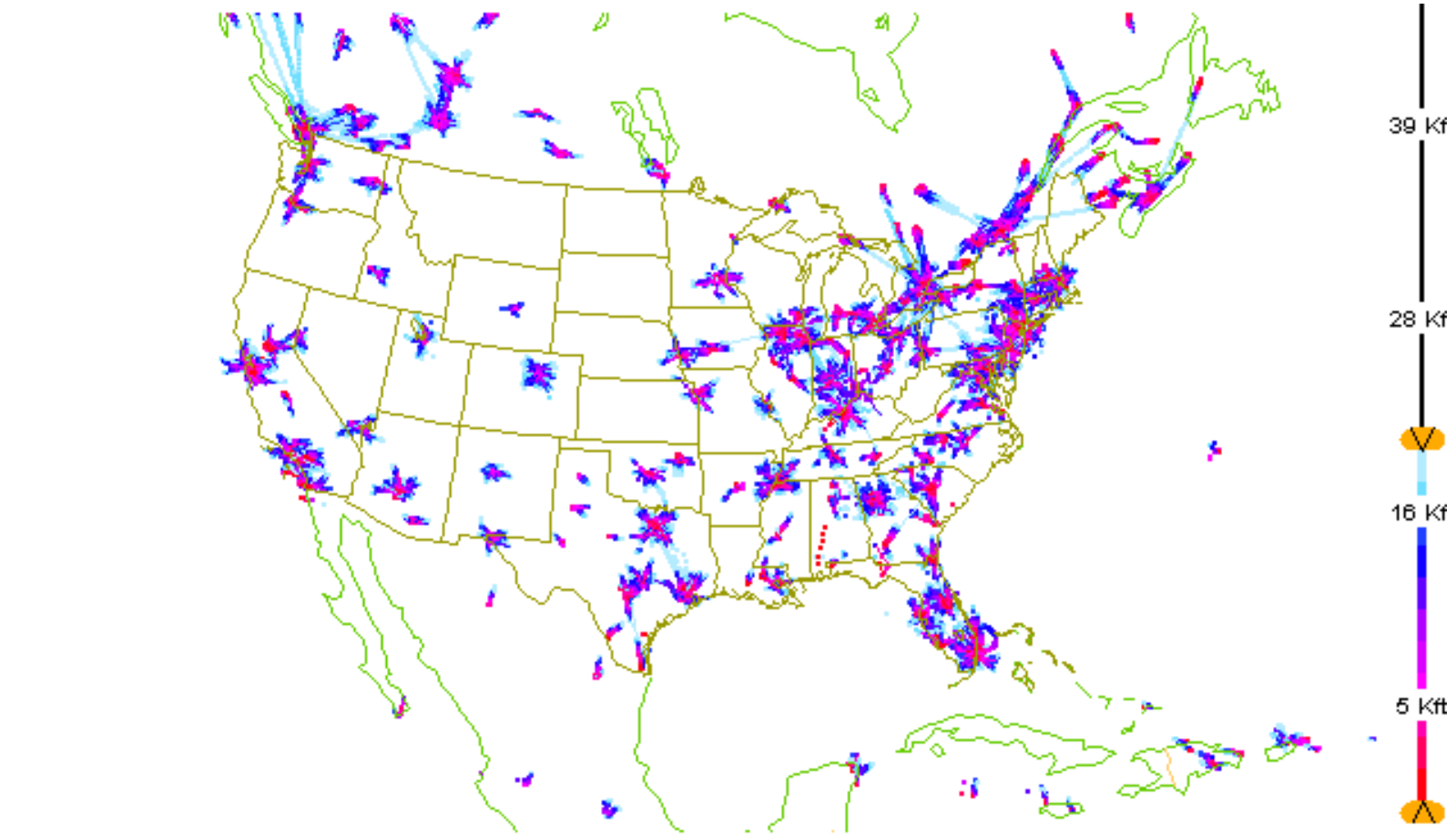


(On RUC assimilation of TAMDAR data) - AMDAR and TAMDAR definitions

- **"AMDAR" (Automated Meteorological Data and Recording) – are automatically sent from commercial aircraft, mostly large jets**

- **"TAMDAR" (Tropospheric AMDAR) – automatic reports from (currently) ~50 turboprops flying regionally in the US Midwest**
  - Provided by AirDat LLC
  - Agreement between Northwest Airlines (Mesaba – regional subsidiary) and AirDat LLC
  - New agreement between NWS/FAA and AirDat for use of TAMDAR

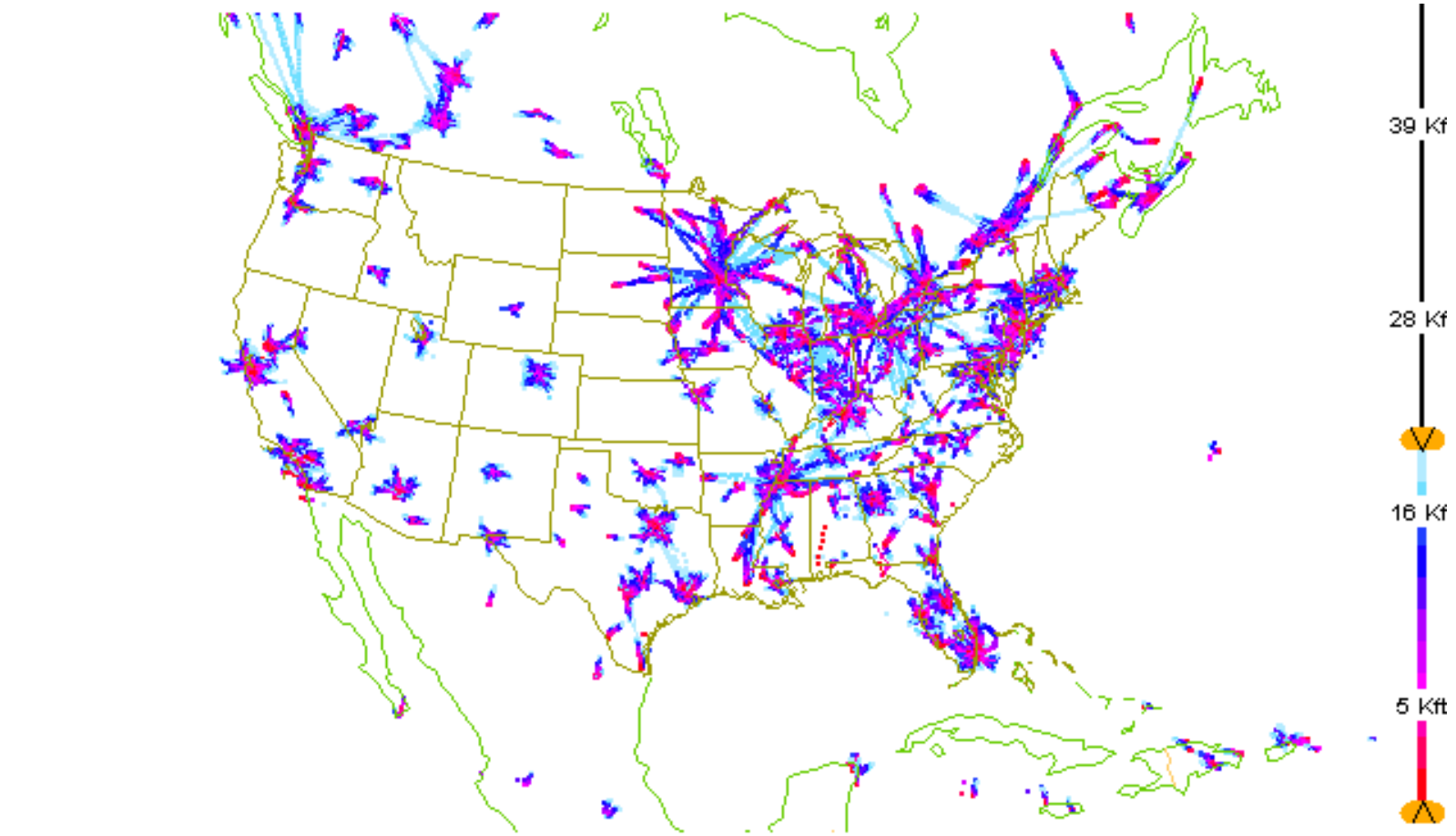
Aircraft coverage is limited to major hubs below 20 Kft,
(without TAMDAR)



05-Jun-2007 00:00:00 -- 05-Jun-2007 23:59:59 (287984 obs loaded, 102442 in range, 9337 shown)

NOAA / ESRL / GSD Altitude: -1000 ft. to 20000 ft. Good w and T not-TAMDAR

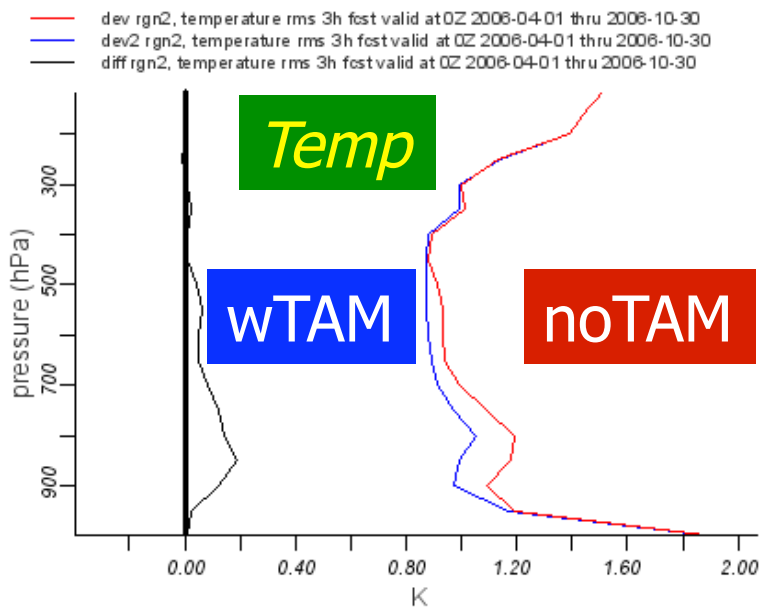
Below 20 Kft, with TAMDAR – better regional coverage in the Midwest

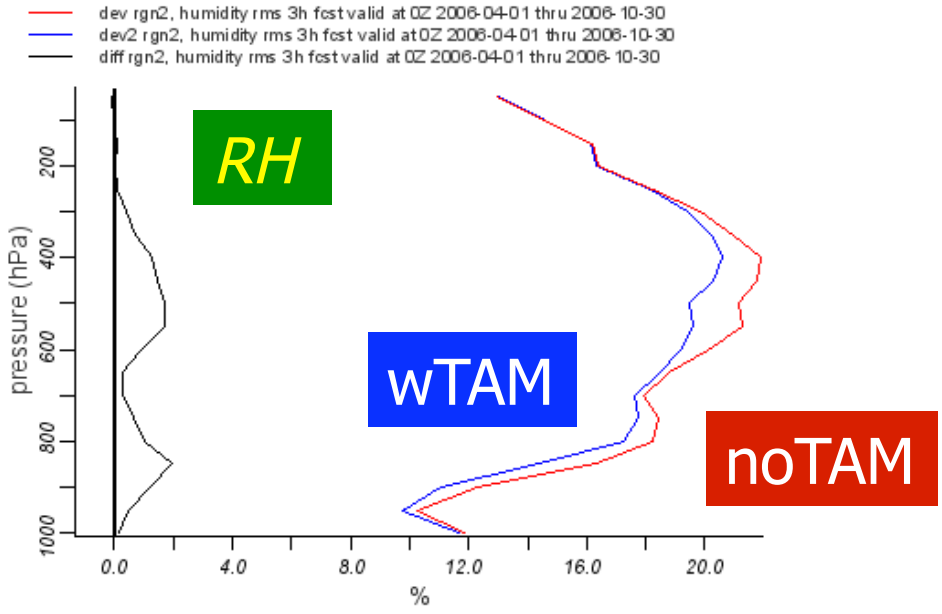


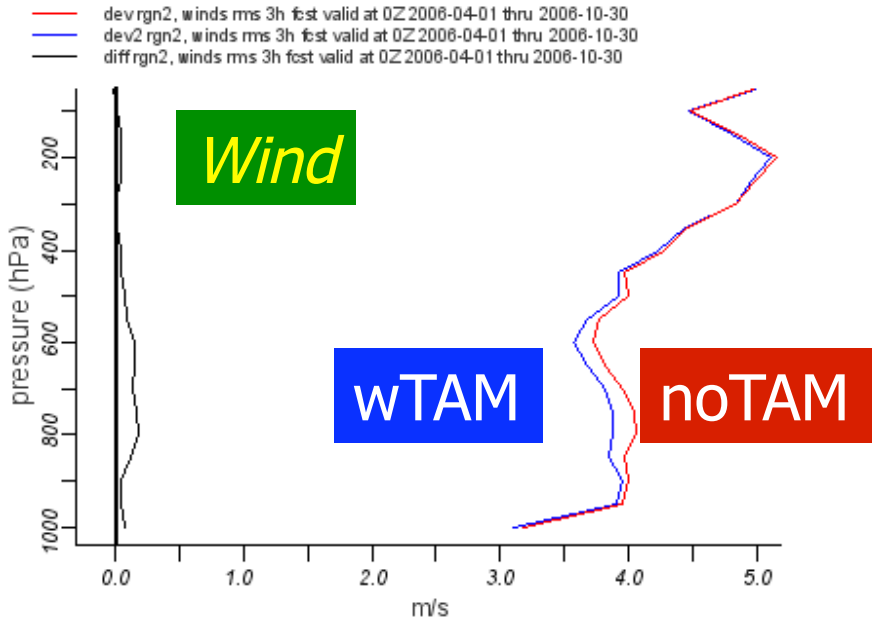
05-Jun-2007 00:00:00 -- 05-Jun-2007 23:59:59 (287984 obs loaded, 112138 in range, 11213 shown)

NOAA / ESRL / GSD Altitude: -1000 ft. to 20000 ft. Good w and T

3h Fcst errors – RUCdev (no TAMDAR), RUCdev2 (w/ TAMDAR)







TAMDAR – regional aircraft with V/T/RH obs

GSD impact study with RUC parallel cycles

- 2005-2007 (ongoing)
- 10-30% reduction in RH, temperature, wind fcst error w/ TAMDAR assimilation

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RRTM Longwave Radiation in RUC Upgrade
Effect on 2-m temperature forecasts

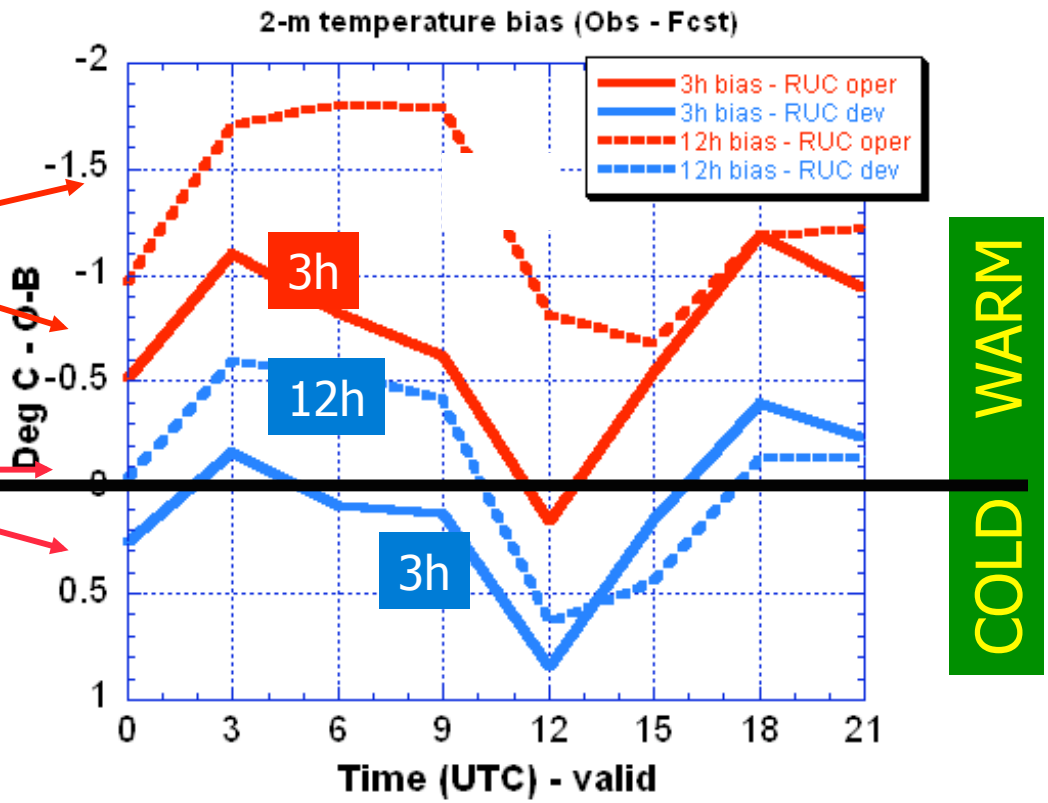
- Much decreased warm bias near surface

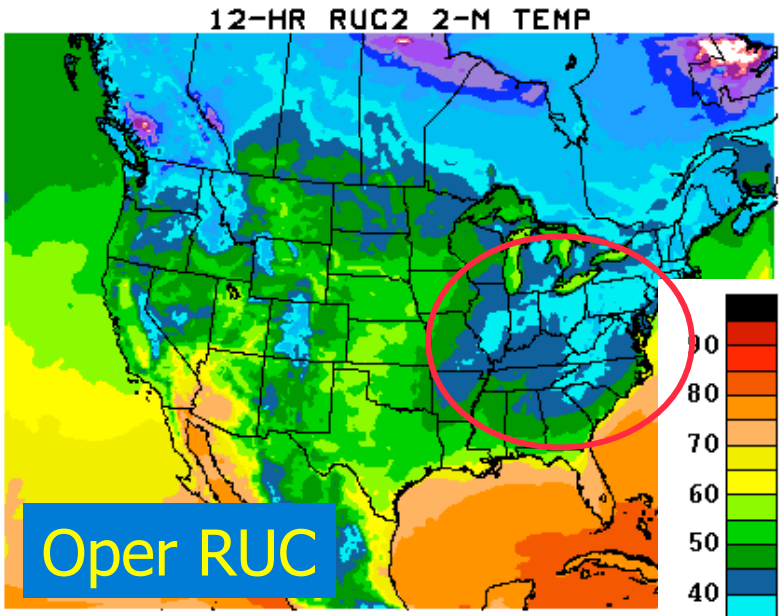
1-month comparison
14 May –13 June 07
Eastern US only

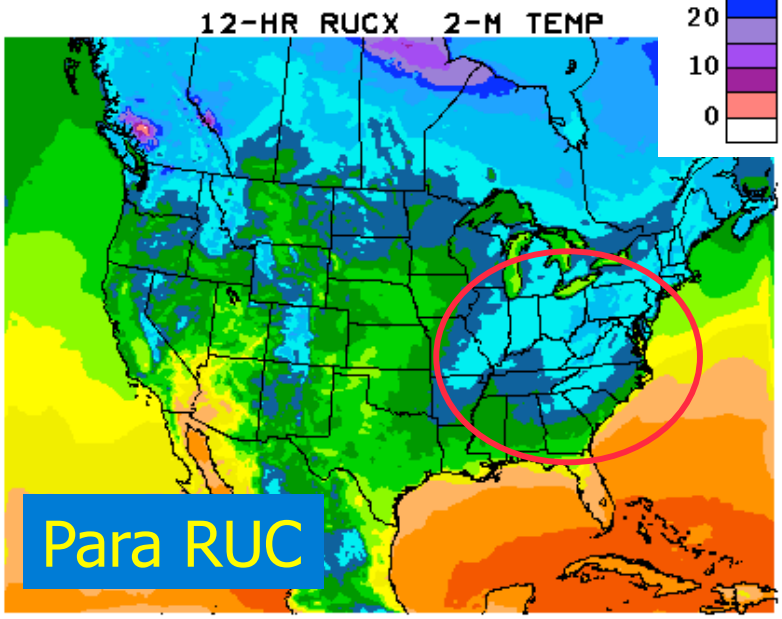
RUC oper – Dudhia LW

RUC para – RRTM LW

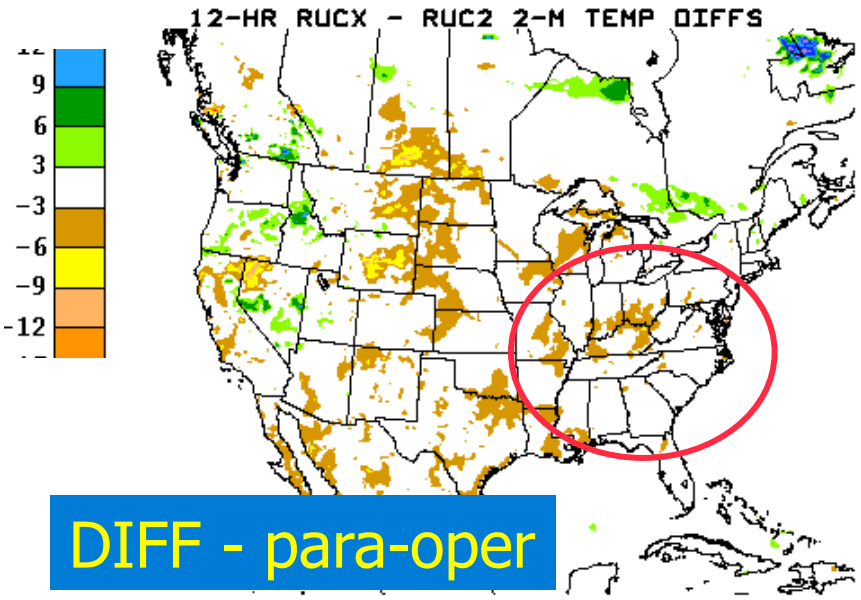
2-m temp bias (obs – forecast)



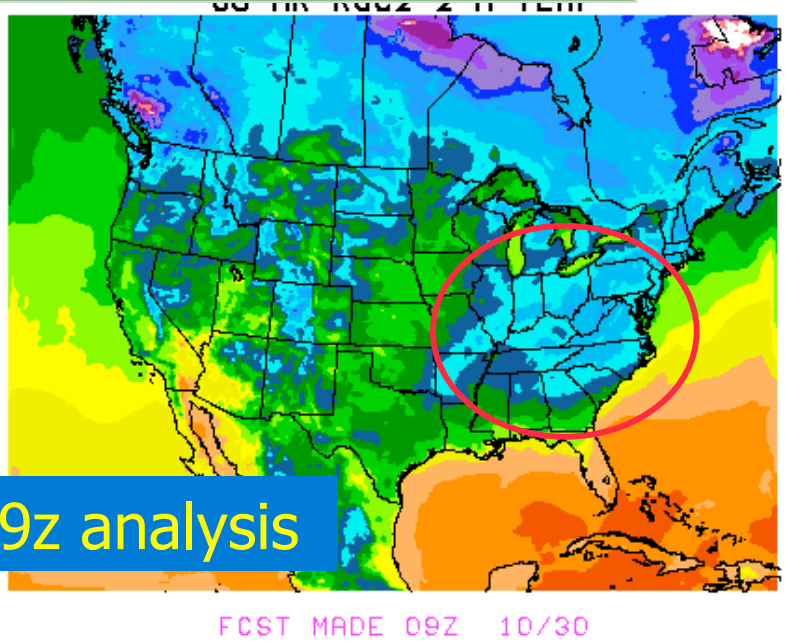




12h fcst – valid 09z 30 Oct



Better 2m temp forecast
From para RUC w/ RRTM LW



Grell-Devenyi Convection

Changes to address recent issues

Reduce weight given to Arakawa-Schubert closure

Result: Reduces the high spatial coverage bias of small amounts

Use smaller depth for cap adequate to deny convective initiation

Result: convection starts later in diurnal cycle

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Remaining tests

- **EMC testing – warm season**

Preliminary evaluation of technical aspects of implementation (assumed to be computational/NCO/ resource issues)

- **None yet**
- **No increase in run time anticipated**
- **Radar reflectivity processing ready to be JIF'd**

Downstream impacts, product changes

- **6 additional 2-d fields in isobaric output files**
- **4 additional 2-d fields in native output files**
- **correction to GRIB identifiers for a few fields**